

REMARKS

Applicant requests favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

Claims 2, 4-7, 12-17, 19-24 and 29-41 are presented for consideration. Claims 2, 12, 22, 29, 34, 36, 38 and 40 are independent. Claims 2, 12, 22, 29, 34, 36, 38 and 40 have been amended to clarify features of the subject invention. Support for these changes and claims can be found in the original application, as filed. Therefore, no new matter has been added. Claims 2, 12, 22, 29, 34, 36, 38 and 40 are the only independent Claims.

Applicant requests favorable reconsideration and withdrawal of the rejections set forth in the above-noted Office Action.

Claims 2-7, 12-17, 19-24 and 29-41 have been rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement in that the claims contain subject matter not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, has possession of the claimed invention. In particular, Claims 2, 12, 22, 29, 34, 36, 38 and 40 have been objected to in that they recite "said converting optical system being arranged to place the predetermined plane and a light entrance surface of said light transmitting element/optical fiber bundle in a Fourier transform relation". With respect to the claims as currently amended, this rejection is respectfully traversed.

The objected-to recitation has been changed to "wherein the light transmitting element has a light entrance surface which is disposed in a Fourier transform relation with said

"predetermined plane" in Claims 2, 22, 34 and 38 and changed to "wherein said optical fiber bundle has a light entrance surface which is disposed in a Fourier transform relation with said predetermined plane" in Claims 12, 29, 36 and 40. These recitations of Claims 2, 12, 22, 29, 34, 36, 38 and 40 are disclosed at lines 15 through 24 of page 12 in the specification with respect to Fig. 8. As a result of these changes, it is believed that Claims 2-7, 12-17, 19-24 and 29-41 as currently amended fully meet the requirements of 35 U.S.C. § 112, first paragraph.

Claims 2-5, 12-15, 19-21, 30, 31 and 34-41 have been rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent 5,218,660 (Omata). Claims 24, 32 and 33 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Omata. With regard to the claims as currently amended, these rejections are respectfully traversed.

Independent Claim 2 as currently amended is directed to an illumination optical system having a total reflection type light transmitting system that illuminates a surface to be illuminated. In the illumination optical system, an imaging optical system forms an image of a light source upon a predetermined plane using light from the light source. A converting optical system directs light from the light source image formed by the imaging optical system to the light transmitting element. The light transmitting element has a light entrance surface disposed in a Fourier transform relation with the predetermined plane.

Independent Claim 34 as currently amended is directed to exposure apparatus in which an illuminating optical system has a total reflection type light transmitting element to illuminate a mask. In the illumination optical system, an imaging optical system forms an image of a light source upon a predetermined plane using light from the light source. A converting optical system

directs light from the light source image formed by the imaging optical system to the light transmitting element. The light transmitting element has a light entrance surface disposed in a Fourier transform relation with the predetermined plane. A projection optical system projects a pattern of the mas onto a wafer.

Independent Claim 38 as currently amended is directed to exposure apparatus that has an illumination optical system having a total reflection type light transmitting element to illuminate a mask. In the illumination optical system, plural light sources illuminate a predetermined plane. A converting optical system disposed between the predetermined plane and the light transmitting element directs light from the plural light sources to the light transmitting element. The light transmitting element has a light entrance surface disposed in a Fourier transform relation with the predetermined plane. A projection optical system projects a pattern of the mask onto a wafer.

Independent Claim 12 as currently amended is directed to an illumination optical system that illuminates a surface to be illuminated with light from a light source by using an optical fiber bundle. In the illumination optical system, an imaging optical system forms an image of a light source upon a predetermined plane using light from the light source. A converting optical system directs light from the light source image formed by the imaging optical system to the optical fiber bundle. The optical fiber bundle has a light entrance surface disposed in a Fourier transform relation with the predetermined plane.

Independent Claim 36 as currently amended is directed to an illumination optical system that illuminates a mask with light from a light source and by using an optical fiber bundle. In the illumination optical system, an imaging optical system forms an image of a light source upon a

predetermined plane by using light from the light source. A converting optical system directs light from the light source image formed by the image optical system to the optical fiber bundle. The optical fiber bundle has a light entrance surface disposed in a Fourier transform relation with the predetermined plane. A projection optical system projects a pattern of the mask onto a wafer.

Independent Claim 40 as currently amended is directed to an illumination optical system that illuminates a mask using an optical fiber bundle. In the illumination optical system, plural light sources illuminate a predetermined plane. A converting optical system disposed between the predetermined plane and the optical fiber bundle directs light from the plural light sources to the optical fiber bundle. The optical fiber bundle has a light entrance surface disposed in a Fourier transform relation with the predetermined plane. A projection optical system projects a pattern of the mask onto a wafer.

In Applicant's view, Omata discloses an illumination device that illuminates a surface with a radiation beam of arcuate cross-section. The device includes a radiation source that produces a radiation beam having a uniform intensity and an optical system with a stop with an arcuate opening to be irradiated with the radiation beam from the source. An image of the arcuate opening irradiated is projected on the surface for illumination of the same. A light pipe assembly directs the radiation beam from the source to the optical system while maintaining a substantially constant angle of opening of the same. The light pipe assembly has plural subassemblies each having an array of light pipes of polygonal cross-section. Those light pipes in the subassemblies close to the source are combined to define an entrance surface of the light pipe assembly while those light pipes of the subassemblies close to the optical system are so

disposed that their exit surfaces are arrayed along an arcuate line similar to the shape of the opening of the stop. The light pipe assembly is adapted to receive the radiation beam from the source to divide the received radiation beam into portions for the subassemblies, respectively whereby the light portions emanating from the exit surfaces of the subassemblies illuminate the surface to be illuminated.

It is a feature of Claims 2, 12, 34, 36, 38 and 40 as currently amended that a light transmitting element or optical fiber bundle of an illumination optical system has a light entrance surface disposed in a Fourier transform relation with a predetermined plane on which an imaging optical system forms an image of a light source. Omata may show a fly's eye lens 3 with a surface 3a that corresponds to the predetermined plane of the present application and light pipe assembly 5 with a light entrance surface 5a that corresponds to the light entrance surface. As shown in Fig. 2 of Omata, however, the light pipe assembly 5 is disposed so that the light entrance surface 5a is optically conjugate with the surface 3a of the fly's eye lens 3. The conjugate relationship of the surfaces 3a and 5a in Omata does not in any manner satisfy the feature of disposing the light transmitting element in a Fourier transform relation with the predetermined plane as in Claims 2, 12, 34, 36, 38 and 40. Accordingly, it is not seen that Omata's conjugate relationship of the surfaces 3a and 5a could possibly teach or suggest this feature of Claims 2, 12, 34, 36, 38 and 40. Therefore, it is believed that Claims 2, 12, 34, 36, 38 and 40 are completely distinguished from Omata and are allowable.

Claims 22 and 29 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Omata. With regard to the claims as currently amended, these rejection is respectfully traversed.

Independent Claim 22 as currently amended is directed to an illumination optical system having a total reflection type light transmitting system that illuminates a surface to be illuminated. In the illumination optical system, plural light sources illuminate a predetermined plane and a converting optical system disposed between the predetermined plane and the light transmitting element directs light from the plural light sources to the light transmitting element. The light transmitting element has a light entrance surface disposed in a Fourier transform relation with the predetermined plane.

Independent Claim 29 is directed to an illumination optical system that illuminates a surface to be illuminated using an optical fiber bundle. In the illumination optical system, plural light sources illuminate a predetermined plane. A converting optical system disposed between the predetermined plane and the optical fiber bundle directs light from the plural light sources to the optical fiber bundle.. The optical fiber bundle has a light entrance surface disposed in a Fourier transform relation with the predetermined plane.

According to the invention defined in Claims 22 and 29 as currently amended, plural light sources illuminate a predetermined plane and a light transmitting element or an optical fiber bundle directs light from the plural light sources to the light transmitting element or the optical fiber bundle. The light transmitting element or optical fiber bundle has a light entrance surface disposed in a Fourier transform relation with the predetermined plane.

As discussed with respect to Claims 2, 12, 34, 36, 38 and 40, Omata only teaches that a light pipe assembly 5 receiving light at its light entrance surface from a fly's eye lens 3 through a lens 4 disposed so that its light entrance surface 5a is optically conjugate with the surface 3a of

the fly's eye lens 3. In contrast to Omata's conjugate relationship between surfaces 3a and 5a, it is a feature of Claims 22 and 29 that a light transmitting element or optical fiber bundle has a light entrance surface (corresponding to Omata's surface 5a) disposed in a Fourier transform relation with a predetermined plane (corresponding to surface 3a of Omata). It is not seen that Omata's conjugate relationship could possibly suggest the Fourier transform relation of Claims 22 and 29. Further, Claims 22 and 29 as currently amended do not include any limitation with respect to a luminous distribution of a shape without a central void. Accordingly, it is believed that Claims 22 and 29 as currently amended are completely distinguished from Omata and are allowable.

A review of the other art of record has failed to reveal anything which, in Applicant's opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record. Applicant submits that the amendments to independent Claims 2, 12, 22, 29, 34, 36, 38 and 40 clarify Applicant's invention and serve to reduce any issues for appeal.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicant respectfully requests favorable reconsideration and early passage to issue of the present application. The Examiner is respectfully requested to enter this Amendment After Final Action under 37 C.F.R. § 1.116.

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Respectfully submitted,



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